
द्रवित पेट्रोलियम गैस के लिए रबड़ की नम्य
नलियाँ — विशिष्टि
(दूसरा पुनरीक्षण)

**Flexible Rubber Tubing for
Liquefied Petroleum Gas —
Specification**
(*Second Revision*)

ICS 23.040.70

© BIS 2023



भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुर शाह ज़फर मार्ग, नई दिल्ली - 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI - 110002
www.bis.gov.in www.standardsbis.in

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Rubber and Rubber Products Sectional Committee had been approved by the Petroleum, Coal and Related Products Division Council.

This standard was first published in 1984 and subsequently revised in 1991.

The flexible rubber tubing covered by this standard is suitable for use in LPG vapour phase only. In order to fall in line with the present manufacturing practices in the country, as well as, to ensure proper matching of the tubing with the regulator and the LPG equipment, covered under IS 4246 Domestic gas stoves for use with liquefied petroleum gases (*fifth revision*); IS 5116 Domestic and Commercial Equipment for Use with LPG — General Requirements (*fourth revision*) and IS 9798 Low pressure regulators for use with liquefied petroleum gas (LPG) (*second revision*), only two sizes of the tubing namely 6.4 mm and 7.0 mm are covered in this standard.

In the first revision, resistance to *iso-octane* test was replaced by resistance to LPG and requirements for hardness, accelerated ageing, resistance to ozone, flexibility and burning behavior on exposure to small flame were included. Considerable assistance was derived from BS 3212 : 1975 'Flexible rubber tubing and hose (including connections where fitted and safety recommendations) for use in LPG vapour phase and LPG/air installations' issued by the British Standards Institution.

In this second revision, besides updating the cross referred standards and BIS Certification marking details, Amendment number 1 and 2 have also been incorporated, and the test method for the determination of shore hardness has also been included .

The safety recommendations for the use and handling of tubing are listed in Annex H.

Rubber hose for liquefied petroleum gas (LPG) is covered under IS 9573 (Part 1) : 2017 Rubber hoses for liquefied petroleum gas — (Part 1) Industrial application (*fourth revision*) and IS 9573 (Part 2) : 2017 Rubber hoses for liquefied petroleum gas — (Part 2) Domestic and commercial application (*fourth revision*).

The composition of the committee responsible for formulation of this standard is listed in Annex J.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

FLEXIBLE RUBBER TUBING FOR LIQUEFIED PETROLEUM GAS — SPECIFICATION

(*Second Revision*)

1 SCOPE

1.1 This standard prescribes the requirements and methods of sampling and test for flexible rubber tubing for use in LPG vapour phase. This tubing is suitable for installation where the working pressure does not exceed 0.005 MPa (5 kPa).

1.2 Flexible tubing covered by this standard is not suitable for gas cutting and allied processes using oxygen.

2 REFERENCES

The standards listed in Annex A contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreement based on standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed in Annex A.

3 TERMINOLOGY

3.1 For the purpose of this standard the definitions given in various parts of IS 7503 and the following shall apply.

3.1.1 LPG

Liquefied petroleum gas (*see* IS 4576).

3.1.2 Tubing

Flexible pipe made of rubber without any reinforcement.

3.1.3 Type Tests

Tests carried out to prove conformity with the specification. These are intended to prove the general qualities and raw materials of the LPG tubing.

3.1.4 Acceptance Tests

Tests carried out on samples taken from a lot for the purpose of acceptance of the lot.

3.1.5 Routine Tests

Tests carried out at manufacturer's work on each LPG tubing to check the requirements which are likely to vary during manufacturing/production.

NOTE — It is recommended that these tests be carried out after every 100 m.

4 REQUIREMENTS

4.1 General

The materials used in the manufacture of tubing shall be homogeneous and shall be resistant to outdoor exposure. The tubing made out of this material shall be green in colour and shall be supplied normally in cut lengths or in rolls of running length. However, when supplied in cut lengths, the pieces shall be of minimum 1.0 m to maximum of 1.5 m in length.

4.2 Workmanship and Finish

The walls shall be seamless and free from all visible defects, such as lumps, blow-holes, cracks etc and the bore shall be clean and free from loose particles which might be carried forward by the gas.

4.3 Dimensions

4.3.1 Diameter

The tubing shall be supplied in 6.40 mm and 7.00 mm inside diameters. The tolerance on nominal inside diameter shall be as per Table 1.

4.3.2 Wall Thickness

It shall comply with thickness as given in Table 1, when measured according to IS 443 (Part 8). The readings shall be taken on a set of six test pieces cut from different sample sections.

4.4 Grip Strength Test

When tested in accordance with the method given in Annex B, the tubing shall comply with the requirements given below.

4.4.1 It shall fit over the standard and oversize metal nozzle shown in Fig. 1, 2 and 3.

4.4.2 It shall remain attached to both nozzles throughout the test period.

4.5 Pressure Test

When immersed in water for 5 min under an internal air pressure of 0.25 MPa or 250 kPa (2.5 bar), the increase in the outside diameter or the tubing shall not be more than 15 percent and there shall be no sign of leakage in the tubing. Also the same shall not burst when the pressure is increased to 0.5 MPa or 500 kPa (5 bar). The test shall be carried out on a length of 60 cm.

4.6 Shore Hardness Test

The hardness on the flat surface of the cut/slit tubing shall be measured as prescribed in IS 3400 (Part 2/Sec 4), the shore hardness shall be $60 \pm 5^\circ\text{A}$.

4.7 Accelerated Ageing Test

The flexible tubing or suitable portion of the tubing shall be subjected to accelerated ageing at a temperature of 100 °C for 72 h in accordance with the normal method prescribed in IS 3400 (Part 4). It shall not show a change of $+ 10^\circ\text{A}$ of its original shore hardness value (*see 4.6*) after accelerated ageing.

4.8 Flexibility Test

4.8.1 The tubing shall be immersed for 72 h in liquid pentane and then conditioned at room temperature for 24 h, after which it shall be tested in accordance with the method prescribed in Annex C, the gas pressure shown on the manometer shall not drop by more than 1 kPa.

4.8.2 The tubing shall be so flexible that it will make contact with a cylindrical former of radius 68 mm for at least 110° of its circumference when the immersed tubing is placed over the former and a mass of 1.6 kg is attached to each end.

4.9 Crushing Test

60 cm long tubing shall be subjected to a crushing force of 350 N applied on the middle of the tubing evenly over a length of 25 mm for 5 minutes, and 30 min after removal of the force it shall not show any deformation or collapse, nor shall it leak when subjected to an internal air pressure of 250 kPa.

4.10 Resistance to *n*-Pentane

When tested in accordance with Annex D, the *n*-pentane absorbed shall not exceed 15 percent of the initial mass of the tubing and the amount of *n*-pentane extractable matter shall not exceed 10 percent of the initial mass of tubing.

4.11 Resistance to Ozone

When tested in accordance with the method described in Annex E, the slit tube shall not show any breakage on surface or cracks or defects.

4.12 Burning Behaviour on Exposure to Small Flame

When tested in accordance with the method described in Annex F, the tubing shall not burn to either of the outer marks within the test period of 45 s.

5 TESTS

5.1 Classification of Tests

5.1.1 Type Tests

The following shall constitute the type tests:

- a) Workmanship and finish (*see 4.2*);
- b) Dimensions (*see 4.3*);
- c) Grip strength test (*see 4.4*);
- d) Pressure test (*see 4.5*);
- e) Hardness test (*see 4.6*);
- f) Accelerated ageing test (*see 4.7*);
- g) Flexibility test (*see 4.8*);
- h) Crushing test (*see 4.9*);
- j) Resistance to LPG (*see 4.10*);
- k) Resistance to ozone (*see 4.11*); and
- m) Burning behaviour on exposure to small flame (*see 4.12*).

5.1.1.1 Criteria for approval

Three samples from three different lots shall be submitted for testing. The testing authority shall issue a type approval certificate if the flexible tubings are found to comply with the requirements of tests given in 5.1.1.

In case of failure in one or more type tests, the testing authority may call for fresh samples and subject them to the test(s) in which the failure occurred. If in the repeat test(s) no failure occurs, the tests may be considered to have been satisfied.

5.1.2 Acceptance Tests

The following shall constitute the acceptance tests;

- Workmanship and finish (*see 4.2*);
- Dimensions (*see 4.3*);
- Pressure test (*see 4.5*);
- Hardness (*see 4.6*);
- Accelerated ageing test (*see 4.7*);
- Flexibility test (*see 4.8*);
- Crushing test (*see 4.9*); and
- Burning behaviour on exposure to small flame (*see 4.12*).

5.1.2.1 For determining the conformity of the lot to the requirements of various acceptance tests as given in **5.1.2**, scale of sampling and criteria for conformity shall be as prescribed in Annex G.

5.1.3 Routine Tests

- Workmanship and finish (*see 4.2*);
- Dimensions (*see 4.3*);
- Hardness (*see 4.6*); and
- Crushing test (*see 4.9*).

6 PACKING AND MARKING

6.1 Packing

The tubing shall be packed as agreed to between the purchaser and the supplier.

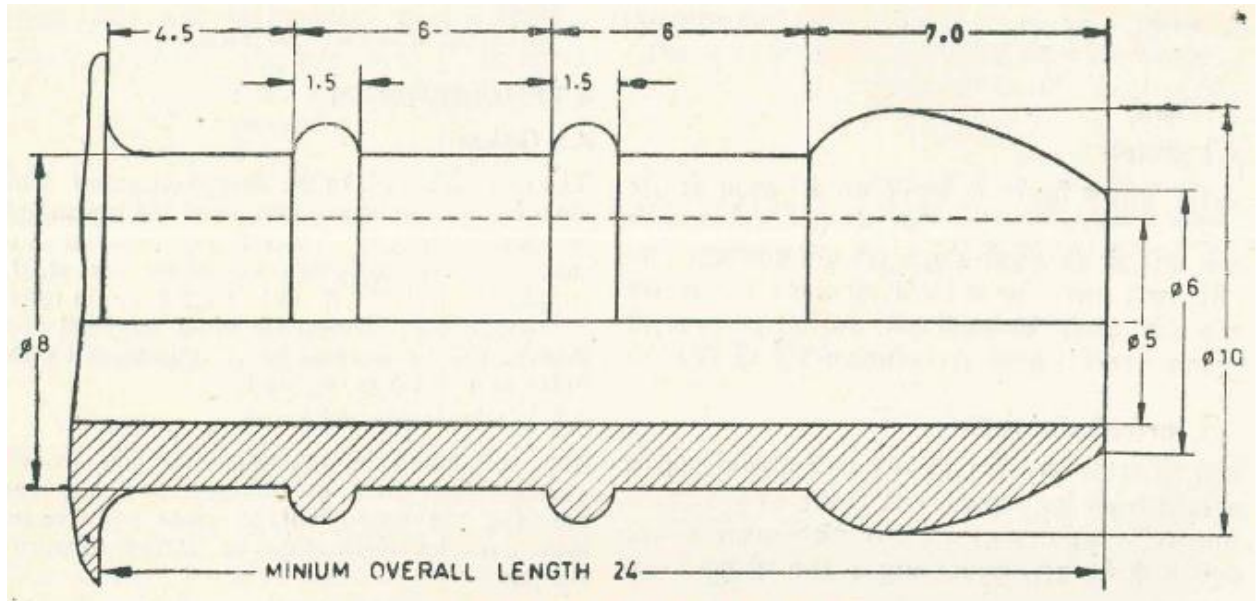
6.2 Each length of flexible tubing shall be clearly marked at the intervals of not more than 1 m with the following information:

- Indication of the source of manufacture;
- Maximum working pressure;
- Nominal bore;
- Month and year of manufacture; and
- This tube shall be replaced on or before month Year (which is 30 months from the date of manufacture).

6.2.1 The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

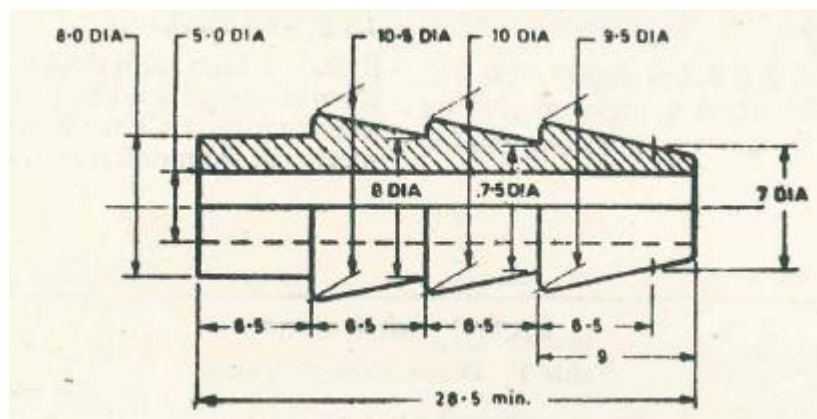
Table 1 Dimensions of Tubing
(Clauses 4.3.1 and 4.3.2)

Sl No.	Inside Diameter, mm		Wall Thickness, mm	
	Bore	Tolerance	Thickness	Tolerance
(1)	(2)	(3)	(4)	(5)
i)	6.40	+ 0.32 – 0.32	3.20	+ 0.32 – 0.00
ii)	7.00	+ 0.35 – 0.10	3.50	+ 0.35 – 0.00



Tolerance on all dimensions ± 0.25
All dimensions in millimetres.

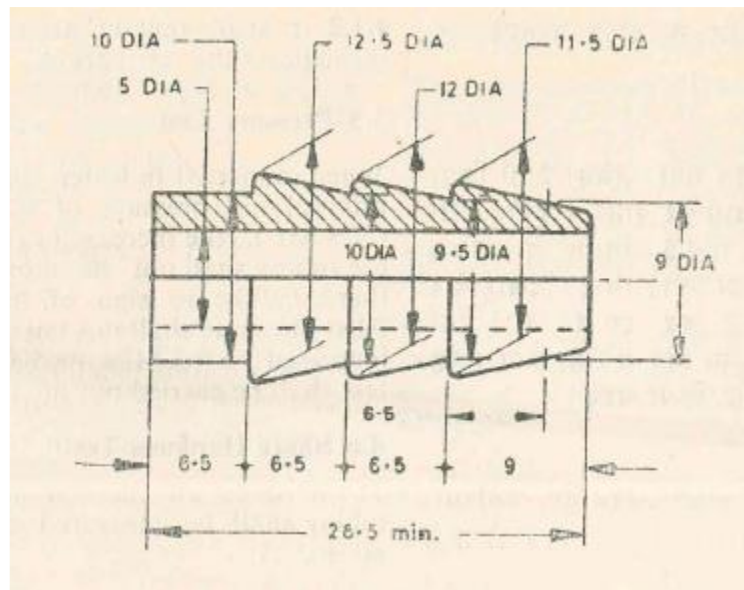
1A Nozzle For 6.4 mm Bore Tubing



Tolerance on all dimensions ± 0.25
All dimensions in millimetres.

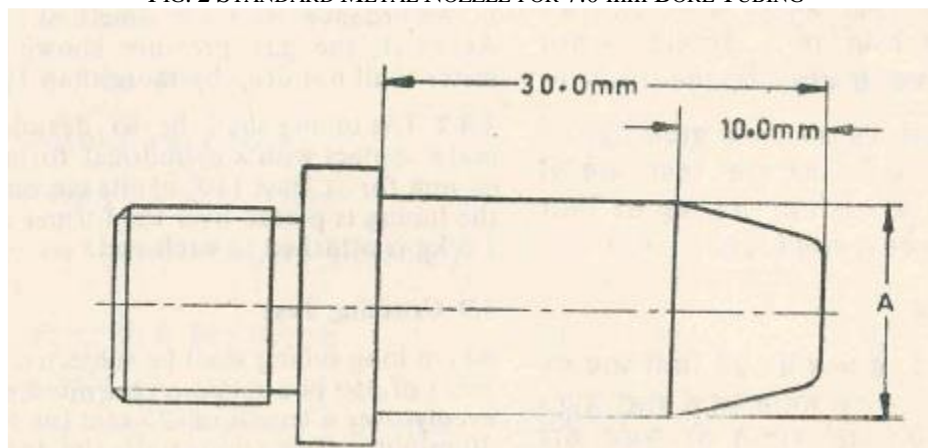
1B Nozzle For 6.4 mm Bore Tubing, Alternate

FIG. 1 STANDARD METAL NOZZLE FOR 6.4 mm BORE TUBING



Tolerance on all dimensions ± 0.25
All dimensions in millimetres.

FIG. 2 STANDARD METAL NOZZLE FOR 7.0 mm BORE TUBING



A — 12.2 mm for 6.4 mm dia tubing and 13.7 mm for 7.0 mm dia tubing
Tolerance on all dimensions ± 0.125 mm

FIG. 3 OVERSIZE METAL NOZZLE

ANNEX A

(Clause 2)

LIST OF REFERRED STANDARDS

<i>IS No.</i>	<i>Title</i>	<i>IS No.</i>	<i>Title</i>
IS 443 (Part 8) : 2023/ISO 4671 : 2022	Methods of Test for Rubber and Plastics — Tubing, Hoses and Hose Assemblies Part 8 Rubber and Plastics Hoses and Hose Assemblies — Methods of Measurement of the Dimensions of Hoses and the Lengths of Hose Assemblies	IS 4576 : 2021	Liquefied petroleum gases — Specification (<i>fourth revision</i>)
IS 3400 (Part 4): 2012/ISO 188 : 2011	Methods of test for vulcanized rubber: Part 4 Accelerated ageing and heat resistance (<i>third revision</i>)	IS 7503 : 2018/ ISO 1382 : 2012	Glossary of terms used in rubber industry
IS 3400 (Part 20) : 2018/ISO 1431- 1 : 2012	Methods of test for vulcanized rubbers: Part 20 Resistance to ozone cracking — Static strain test (<i>second revision</i>)	IS 3400 (Part 2/Sec 4) : 2022/ ISO 48-4 : 2018	Rubber, vulcanized or thermoplastic: Part 2 Determination of hardness, Section 4 Indentation hardness by durometer method (Shore hardness) (<i>second revision</i>)
		IS 4905 : 2015/ISO 24153 : 2009	Random sampling and randomization procedures (<i>first revision</i>)

ANNEX B

(Clause 4.4)

GRIP STRENGTH TEST

B-1 PROCEDURE

B-1.1 Four specimens of tubing each 150 mm long and clean of lubricant, shall be tested.

B-1.2 Force each test piece over a standard nozzle (*see* Fig.1 and 2) at one end and on oversize nozzle at the other (*see* Fig. 3). The oversize nozzle shall consist of a cylindrical piece of metal of diameter corresponding to that shown in Fig. 3. Attach each standard nozzle to a hook and suspend the test pieces so that the axis of the tubing and nozzle are in the same vertical straight line. Attach a mass of 4.5 kg

to the lower (oversize) nozzle and leave the assembly for half an hour. Reject a test piece if it slips off either nozzle during this period.

B-1.3 Place the test assembly without mass not rejected, in an ageing oven and leave them for 72 h at 100 °C. Then examine the test pieces for signs of splitting or cracks.

B-1.4 Cool to room temperature and then test the assemblies for leaks at 70 kPa air pressure under water for 5 min.

ANNEX C

(Clause 4.8.1)

FLEXIBILITY TEST

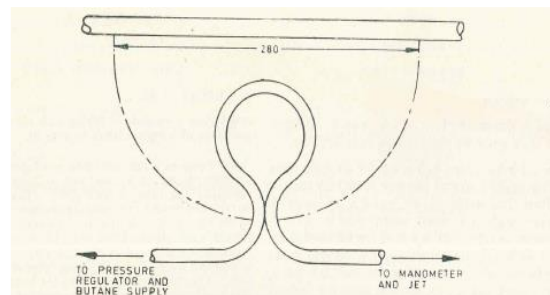
C-1 PROCEDURE

C-1.1 Connect one end of a straight length of tubing to a supply of butane gas or air and the other end to a water manometer calibrated in millipascals and a jet which permits flow of gas at 0.225 m³/h at 2.6 kPa in such a way that about 0.6 m of tubing lies horizontally on the bench. Adjust the pressure of the gas to read 2.6 kPa on the manometer with the gas flowing through the orifice. Place a rule marked in millimetres on the bench alongside the tubing under test.

C-1.2 Take in the fingers two points on the tubing spaced 280 mm and bring them together so that the tubing takes the form of a loop (see Fig. 4).

C-1.3 Hold the loop for 30 s and record any pressure

drop shown on the manometer during this period.



To manometer and jet
To pressure regulator and butane supply
FIG. 4 DIAGRAM ILLUSTRATING FLEXIBILITY TEST

ANNEX D

(Clause 4.10)

TEST FOR RESISTANCE TO *n*-PENTANE

D-1 PROCEDURE

Immerse a weighed portion of the tubing in liquid *n*-pentane, minimum 98 percent at room temperature for 72 h. The volume of the *n*-pentane shall be at least 50 times the volume of the test piece. Following immersion, reweigh the test piece after 5 min conditioning in air at room temperature and reweigh again after 24 h further conditioning under the same conditions.

D-2 CALCULATION

Calculate the percentage *n*-pentane absorbed and the *n*-pentane extractable matter as follows:

$$\text{a) Percentage } n\text{-pentane absorbed} = \frac{(M_1 - M_2)}{M_0} \times 100$$

$$\text{b) Percentage } n\text{-pentane extractable matter} = \frac{(M_0 - M_2)}{M_0} \times 100$$

where

- M_0 = initial mass of sample;
 M_1 = mass of sample after immersion and 5 min conditioning; and
 M_2 = mass of sample after 24 h further conditioning.

ANNEX E

(Clause 4.11)

TEST FOR RESISTANCE TO OZONE

E-1 TEST PIECE

E-1.1 The test piece shall be a 150 mm length of tubing.

E-2 APPARATUS

E-2.1 As described in 5 of IS 3400 (Part 20).

E-3 PROCEDURE

E-3.1 Slit 150 mm long tubing into two parts. Draw a reference line on outside surface and fix the same at one end in a suitable jig, the other end being fixed

in a jig after giving it a twist of 180° to the half cut tube sample.

E-3.2 Place the assembly with a minimum of two samples and expose it in the ozone cabinet to an ozone concentration of (50 ± 5) pphm at $(40^\circ \pm 1)^\circ\text{C}$ for 72 h.

E-3.3 After exposure, remove the samples from the ozone chamber and release them from the assembly. Check for any breakage, crack or any other surface defects.

ANNEX F

(Clause 4.12)

TEST FOR BURNING BEHAVIOUR ON EXPOSURE TO SMALL FLAME

F-1 PROCEDURE

F-1.1 Support a length of not less than 150 mm of the tubing horizontally. Make three marks on the tubing, the middle one approximately midway along the tubing with one on either side 50 mm from the middle mark. Direct a well-aerated bunsen burner flame (approximately 1 800 KJ/h and about 25 mm in diameter) on to the tubing so that the flame is horizontal, in the plane of the tubing and perpendicular to the axis of the tubing, the central

mark being in the middle of the flame (*see* Fig. 5).

F-1.2 Apply the flame for 5 s and then remove it for 1 s. Repeat the application of the flame until the material catches fire and continues to burn or until a total test period of 45 s has elapsed. If the material catches fire and continues to burn without further application of the flame, note whether the flame reaches either of the outer marks within 45 seconds of the commencement of test.

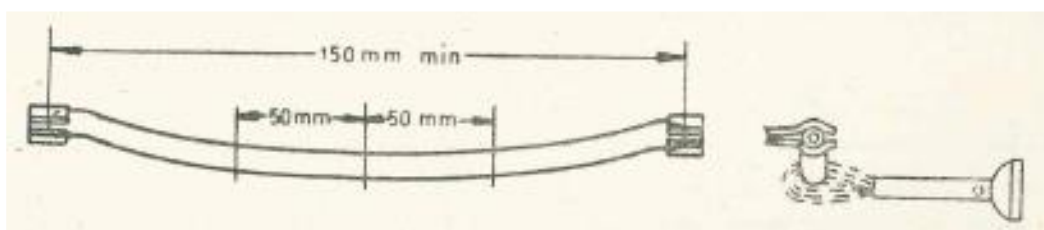


FIG. 5 TEST FOR BURNING BEHAVIOUR

ANNEX G

(Clause 5.1.2.1)

SAMPLING AND CRITERIA FOR CONFORMITY

G-1 SCALE OF SAMPLING

G-1.1 Lot

All the LPG tubings of the same dimensions, same composition and vulcanized at one time shall constitute a lot.

NOTE — Each lot shall be tested separately for the various requirements of the specification.

G-1.2.0 Sampling Plan for Acceptance Test

The number of LPG tubings (cut into a length of 1 m each) to be sampled from each lot is given in Table 2. The sample shall be drawn by the method of random selection as per IS 4905.

G-1.2.1 Each of the LPG tubings selected according to col (3) of Table 2 shall be examined for workmanship and finish (*see 4.2*) and dimensions (*see 4.3*). An LPG tubing failing in one or more of these requirements shall be termed as defective. The lot shall be considered to have satisfied these

requirements if the number of defectives found in the sample is less than or equal to the acceptance number given in col (4) of Table 2.

G-1.2.2 The lot having been found satisfactory shall be further tested for pressure (*see 4.5*), hardness test (*see 4.6*), accelerated ageing test (*see 4.7*), Flexibility test (*see 4.8*), crushing test (*see 4.9*) and burning behaviour (*see 4.12*) as given in col (5), (6) and (7) of Table 2.

G-1.2.3 For this purpose sub-samples consisting of LPG tubings (of 1 metre) given in col (5), (6) and (7) shall be taken from the lot. These shall be taken from the samples of LPG tubings already examined and found satisfactory according to **G-1.2.1**.

G-1.2.4 Each of the LPG tubings in the sub-sample shall be subjected to the relevant tests as given in col (5), (6) and (7) of Table 2.

G-1.2.5 The lot shall be declared as conforming to the requirements of the specification if no failure occurs in any of the sub-samples.

Table 2 Scale of Sampling

(Clause G-1.2.0)

Sl No.	Lot Size	For Visual and Dimensional Characteristics (Clause 4.2 and 4.3)		Sub-Sample Size, for Clauses		
		Sample Size	Acceptance Number	4.5 & 4.6	4.7 & 4.8	4.9 & 4.12
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Up to 500	5	0	2	1	2
ii)	501 to 1 000	8	0	3	1	2
iii)	1 001 to 1 500	13	0	5	2	4
iv)	1 501 to 2 000	20	1	8	2	4
v)	2 001 and above	32	2	13	3	6

ANNEX H*(Foreword)***SAFETY RECOMMENDATIONS FOR USE AND HANDLING OF LPG TUBING**

H-1 The following recommendations are intended to assist generally in the safe operation of tubing complying with the requirements of this standard but they are particularly intended to provide guidance to appliance manufacturers.

H-2 Care should be taken to ensure that the design of an appliance is such that when tubing is fitted it is not subjected to a bend radius less than that given below:

<i>Nominal Bore (mm)</i>	<i>Bend Radius, Min (mm)</i>
6.40	77
7.00	84

H-3 Care should be taken to ensure that any clips, clamps or spigots used to retain the tubing on the fitting are free from any rough edges and are not over-tightened. Excessive compression of the tubing is unnecessary and may lead to deleterious effects.

H-4 Care should be taken to ensure that the tubing does not come into direct contact with parts of the appliance which become hot during use.

H-5 The tubing should not be used in a situation where the ambient temperature is greater than 60 °C.

ANNEX J

(Foreword)

COMMITTEE COMPOSITION

Rubber and Rubber Products Sectional Committee, PCD 13

<i>Organization</i>	<i>Representative(s)</i>
Rubber Research Institute of India, Rubber Board, Kottayam	DR SIBY VARGHESE (Chairperson)
All India Rubber Industries Association, Mumbai	SHRI SRIKANTH KRISHNAMURTHY SHRI CHINMOY RAY (<i>Alternate</i>)
Apcotex Industries Ltd	DR S. V. GOVINDRAJU
Association of Latex Producers of India, Kerala	SHRI SATISH ABRAHAM
Association of Planters of Kerala, Thiruvananthapuram	SHRI SANTOSH KUMAR SHRI PHILIP C. JACOB (<i>Alternate</i>)
Automotive Tyres Manufacturers Association (ATMA), New Delhi	SHRI RAJIV BUDHRAJA SHRI NITEESH K. SHUKLA (<i>Alternate</i>)
Block Rubber Processors Association of India, Mumbai	SHRI RAJIV THARIAN SHRI RONNY JOSEPH (<i>Alternate</i>)
Directorate General of Quality Assurance (DGQA), Ministry of Defence, New Delhi	SHRI S. K. SAXENA SHRI V. K. CHHABRA (<i>Alternate</i>)
Dow Corning India Pvt Ltd, Mumbai	SHRI SUBHRANSHU GUPTA
Flame Retardants Association of India, Gurgaon	SHRI P.V. MURALI MOHAN
GRP Ltd, Mumbai	SHRI KALYAN DAS SHRI K. M. RAVI (<i>Alternate</i>)
HASETRI	DR SAIKAT DAS GUPTA
Indian Oil Corporation R&D Centre – Faridabad, Haryana	DR DEEPAK SAXENA DR PANKAJ BHATNAGAR (<i>Alternate</i>)
Indian Rubber Manufacturers Research Association (IMRA), Mumbai	DR K. RAJKUMAR DR BHARAT KAPGATE (<i>Alternate</i>)
Indian Synthetic Rubber Pvt Ltd (ISRPL) Noida	SHRI LALIT KUMAR SHARMA SHRI BHANU PRATAP SINGH (<i>Alternate I</i>) SHRI TUHIN KANTI DAS (<i>Alternate II</i>)
KA Prevulcanized, Tamilnadu	SHRI PRAVEEN MATHEW
LPG equipment research centre, Bangalore	SHRI SANTOSH K GUPTA SHRI ASHIS KUMAR BERA (<i>Alternate</i>)
LANXESS India Pvt Ltd, Kolkata	SHRI ARINDAM GHOSH
MRF Ltd, Chennai	SHRI G. SHYJU DR P. INDUMATHI (<i>Alternate</i>)

<i>Organization</i>	<i>Representative(s)</i>
Newage Fire Protection Industries Pvt Ltd	SHRI BHARAT J. SHAH SHRI JAYANT SINHA (<i>Alternate</i>)
Rado Industries Ltd, Faridabad	SHRI KAILASH GUPTA
Reliance Industries Ltd, Vadodara	DR ABHIJIT ADHIKARY SHRI SHAMBHU LAL AGARWAL (<i>Alternate</i>)
Research, Designs & Standards Organization (RDSO), Lucknow	SHRI P. K. BALA SHRI MANOJ MINZ (<i>Alternate</i>)
Shri Sati Rubber Industries, Jaipur	SHRI VIJAY KUMAR AGARWAL SHRI SUDHIR AGARWAL (<i>Alternate</i>)
Voluntary Organization in Interest of Consumer Education (VOICE), New Delhi	SHRI M. A. U. KHAN SHRI H. WADHWA (<i>Alternate</i>)
In Personal Capacity (A-302-303, Casa Central, Sarabhai Compound, Genda Circle, Vadiwadi Vadodara – 390007)	DR ARUP K. CHANDRA
In Personal Capacity (3A, Regent Place, 20 Habibullah Road, T. Nagar — 600017)	DR RANJIT K. MATTHAN
In Personal Capacity (<i>Kerala</i>)	DR SUNNY SEBASTIAN
BIS Directorate General	SHRIMATI MEENAL PASSI, SCIENTIST ‘F’/SENIOR DIRECTOR AND HEAD (PETROLEUM, COAL AND RELATED PRODUCTS) [REPRESENTING DIRECTOR GENERAL (<i>Ex-officio</i>)]

Member Secretary
SHRI RAJAT GUPTA
SCIENTIST ‘B’/ASSISTANT DIRECTOR
(PETROLEUM, COAL AND RELATED PRODUCTS), BIS

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act, 2016* to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Head (Publication & Sales), BIS.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the website- www.bis.gov.in or www.standardsbis.

This Indian Standard has been developed from Doc No.:PCD 13 (21062).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 2323 0131, 2323 3375, 2323 9402

Website: www.bis.gov.in

Regional Offices:

	Telephones
Central : 601/A, Konnectus Tower -1, 6 th Floor, DMRC Building, Bhavbhuti Marg, New Delhi 110002	{ 2323 7617
Eastern : 8 th Floor, Plot No 7/7 & 7/8, CP Block, Sector V, Salt Lake, Kolkata, West Bengal 700091	{ 2367 0012 2320 9474
Northern : Plot No. 4-A, Sector 27-B, Madhya Marg, Chandigarh 160019	{ 265 9930
Southern : C.I.T. Campus, IV Cross Road, Taramani, Chennai 600113	{ 2254 1442 2254 1216
Western : Plot No. E-9, Road No.-8, MIDC, Andheri (East), Mumbai 400093	{ 2821 8093

Branches : AHMEDABAD. BENGALURU. BHOPAL. BHUBANESHWAR. CHANDIGARH. CHENNAI. COIMBATORE. DEHRADUN. DELHI. FARIDABAD. GHAZIABAD. GUWAHATI. HIMACHAL PRADESH. HUBLI. HYDERABAD. JAIPUR. JAMMU & KASHMIR. JAMSHEDPUR. KOCHI. KOLKATA. LUCKNOW. MADURAI. MUMBAI. NAGPUR. NOIDA. PANIPAT. PATNA. PUNE. RAIPUR. RAJKOT. SURAT. VISAKHAPATNAM.